Impounding Dam & Filtration Plant

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G. D. Tompkins

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Nelson, Chas. J.
Impounding dam and
filtration plant

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G. Dwight Tompkins.

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Alfred E. Phillips
Prof. [illegible]

Howard M. Raymond.
Dean of Eng Studies.

L. C. Monin,
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IMPOUNDING DAM AND FILTRATION PLANT.

At the present time a public water supply system is considered more in the light of a necessity than a luxury. The fact is more universally recognized that supplies obtained from shallow wells situated near defective cesspools and out houses are a menace to health. Since the individual supply is obtained, in a majority of cases, from the ordinary shallow well, and the cost of deep wells makes their construction impossible by most people, the problem must be solved by a concentrated effort of the municipality. This effort to take the form of a single source of supply which is known to be uniformly good.

Another important function of a water supply, is that of furnishing the necessary water for flushing a sanitary sewerage system. Such a system is manifestly of slight value otherwise.

Besides furnishing an improved supply from a sanitary stand point the system may also be made to furnish a supply of greater value to the domestic and commercial consumers, such as, soft water in place of hard well water, greater and more efficient fire fighting facilities, and the use in the convenient fixtures (bathtubs, lavatories, etc.) tending toward a higher plane of civilization.

The quality of water for ordinary household purposes is of great importance. Waters containing considerable amounts of alkaline earths, as those from deep wells, etc., are not only unsuitable for culinary purposes but also for washing on account of their action upon soap, requiring excessive amounts

of the same as possible and [illegible]. [illegible] not desirable.

Generally speaking [illegible] a soft water is desirable and in many cases necessary. The formation of boiler scale from hard water is of great economical import. In paper and bleaching works and dye works the use of water containing iron is impossible. Breweries, distilleries, and sugar and starch manufactories, require a water free from micro-organisms.

THE CONDITIONS AT RIVERSIDE [illegible] FILTRATION.

The water supply at Riverside is obtained from two sources; the one being artesian wells driven into water-bearing stratum of the Potsdam sandstone, the other being the Des Plaines River.

The water from the Des Plaines River when filtered will meet all the above requirements at the same time furnishing a drinking water which will be clear and free from dangerous pathogenic organisms.

The first yields a bacteriologically pure water but contains a large amount of minerals and alkaline earths in solution. The extreme hardness of the water makes it undesirable for all purposes except drinking, as shown above. The quantity available is somewhat limited. In the vicinity of Riverside the draught is so great that the exhaustion is felt for several miles distant. (Turneaure and Russel). The reduction in head has made the use of deep-well pumps imperative. These pumps being of low efficiency, the cost of maintenance

is very high. Also the first cost of installation of deep wells and pumps is extremely high.

The Des Moines River receives sewage pollution several miles up stream from the proposed site of the reservoir. Chemical analysis shows the water to contain nitrites and a large amount of free and albuminoid ammonia in the samples taken at the sight of the reservoir. Also Bacteriological analysis shows the presence of B. Coli. Communis and other bacteria. From this analysis it is evident that filtration must be resorted to if the water from this source is to be used.

The reconnaissance survey was made with a view of determining the location and kind of reservoir and settling basin to be used. From the reports of the U. S. it was found that the minimum flow for the dryest year was zero flow for a period of three months. This makes a storing reservoir of 90,000,000 gallons necessary.

Half a mile north of the city the most suitable location was found. At this point the channel of the river widens. By the erection of a low dam a reservoir of 67,000,000 gallons capacity may be obtained. The dredging out of a portion of the lowlands will give a reservoir of the required capacity. This will also act as a settling basin. The topography at this point is such that a dam and the filter beds can be constructed at a conservative cost.

There are two general classes of filtration; by mechanical filters and by slow sand filters. The latter may be divided into two classes; intermittent and continuous.

The [illegible] filter is [illegible] [illegible] ary [illegible] raking or agitation [illegible]. It is also called the [illegible] filter, and is designed to accomplish the purification of water with [illegible] as does the slow sand filter. The filtering material is used in depth from two to four feet deep. The other points are as follows; the very rapid rate of filtration usually from 100 to 125 million gallons per acre per day, the use of a coagulant to aid in filtration, the manner of washing the sand bed and the mechanical details.

The slow sand filter is essentially a sand bed of a predetermined depth enclosed in a water-tight reservoir. On the bottom of the reservoir are collecting drains. Above these for a small depth is placed a layer of coarse gravel of decreasing size. Above this is a layer of sand which is the true filtering medium. The water is put on upon the beds, then filters through, then is collected in the drains and carried to a pure water reservoir. This system has a slow rate of filtration usually not exceeding two (2) to four (4) million gallons per acre per day. In choosing a system of filtration, the various points of each of the above were considered and the slow sand filter determined upon for this particular case. In the case of the mechanical filters about ten per cent of the water passing is necessary for washing the sand while for slow sand filters only one per cent is used. The efficiency of a slow sand filter is also considerably higher than that of a mechanical filter owing to the slower rate of filtration. The use of a coagulant in connection with mechan-

[illegible] filter is also an [illegible] of [illegible]. To obtain uniformly good results with [illegible] requires very careful operation. The water must be analyzed, chemically in order to adjust the amount of coagulant especially where the alkalinity is low, as in this case. For slow sand filters these [illegible] are unnecessary. In both cases however a systematic bacteriological examination of the effluent should be carried on.

The economy of mechanical filters is in their low first cost; also in cases where a settling basin is impossible and where cost of ground makes the large sand filters prohibitive. We believe that in this case the case of constructing a settling basin and reservoir and the cheapness of land removes these latter objections to the slow sand filter.

In most small towns the supervision of such matters is badly neglected, therefore we think that the efficiency of the mechanical filter would be greatly reduced. Since the slow sand filter is practically self operating after installment and produces uniform results, even with poor supervision, its use in small towns is advantageous. These several reasons lead to our selection of a slow sand filter with a mean rate of 1,910,000 gallons per acre per day and a maximum rate of 2,540,000 per acre per day.

THE RESERVOIR AND DAM.

A stadia survey of the site of the reservoir was made and a map drawn. (See Plate I.) Cross sections were also taken at the proposed site of the dam and at three points above the same. (See Plate II.) From these sheets the capacity of the reservoir was computed for different levels and the

[illegible]

[illegible] impounding [illegible] of water. [illegible] Geological Survey maps of this region were studied and it was found that the raising of the river the required amount would not flood any valuable property upstream.

The foundation for the dam was found to be good compact gravel and a hollow reinforced concrete dam was determined upon because of its great stability under extreme conditions of high water and its relatively low cost.

The length and position of the dam was determined by triangulation as were the positions of the intake crib and pumping station and filter beds. (See Plate III.)

The dimensions and details shall be as set forth in Plates IV and V. of this thesis.

FILTER PLANT.

Intake Crib.

The intake crib was designed to remove the heavier suspended matter and to provide at all times an ample supply of water for the suction pipe. It also acts as a protection against injury. The crib is to be designed as shown in Plate VI. and to be placed as shown in Plate III. The top and sides are to be covered with gravel screened to pass a three inch ring and be held on a one and one half inch ring.

Pumping Station.

The design and details of the pumping station are shown on Plate VI. Since concrete is to be used in the building of the dam and filter beds it will be cheaper and better to use it in this case. No forms are necessary for the walls. The

timber is placed [illegible]. [illegible]
thus formed concrete is tamped. The building [illegible]
wall is plastered with a one inch coat of cement mortar one to three. The pump used is a six inch, single stage, centrifugal pump. This pump requires ten horse power, which is supplied by two gasoline engines of ten horse power capacity each. These are attached by means of a friction clutch to the driving pulley which is bolted to the pump. Storage capacity of fourteen hundred gallons of gasoline is provided equivalent to fifty days supply.

Filter Beds.

The rate of filtration has been steadily decreasing since the first installation of filters. The experiments of the Massachusetts State Board of Health and those in Europe have shown that the highest efficiency is obtained for rates between two and three million gallons per acre per day.

In the design of a filter plant the first question to be settled is the rate of filtration. In this latitude a cover is necessary to protect the filter from freezing. The cover was designed to sustain a load of eighty pounds per square foot. A system of roof slabs, stringers, beams and columns was chosen as the most economical and easy of construction.

The details of the filter beds are shown in Plates VII. and VIII. There are four separate beds each of the design set forth in these Plates for one bed. All the beds are built in connection as one structure. The inlet pipes are provided with float valves and floats set to keep the water at the required level.

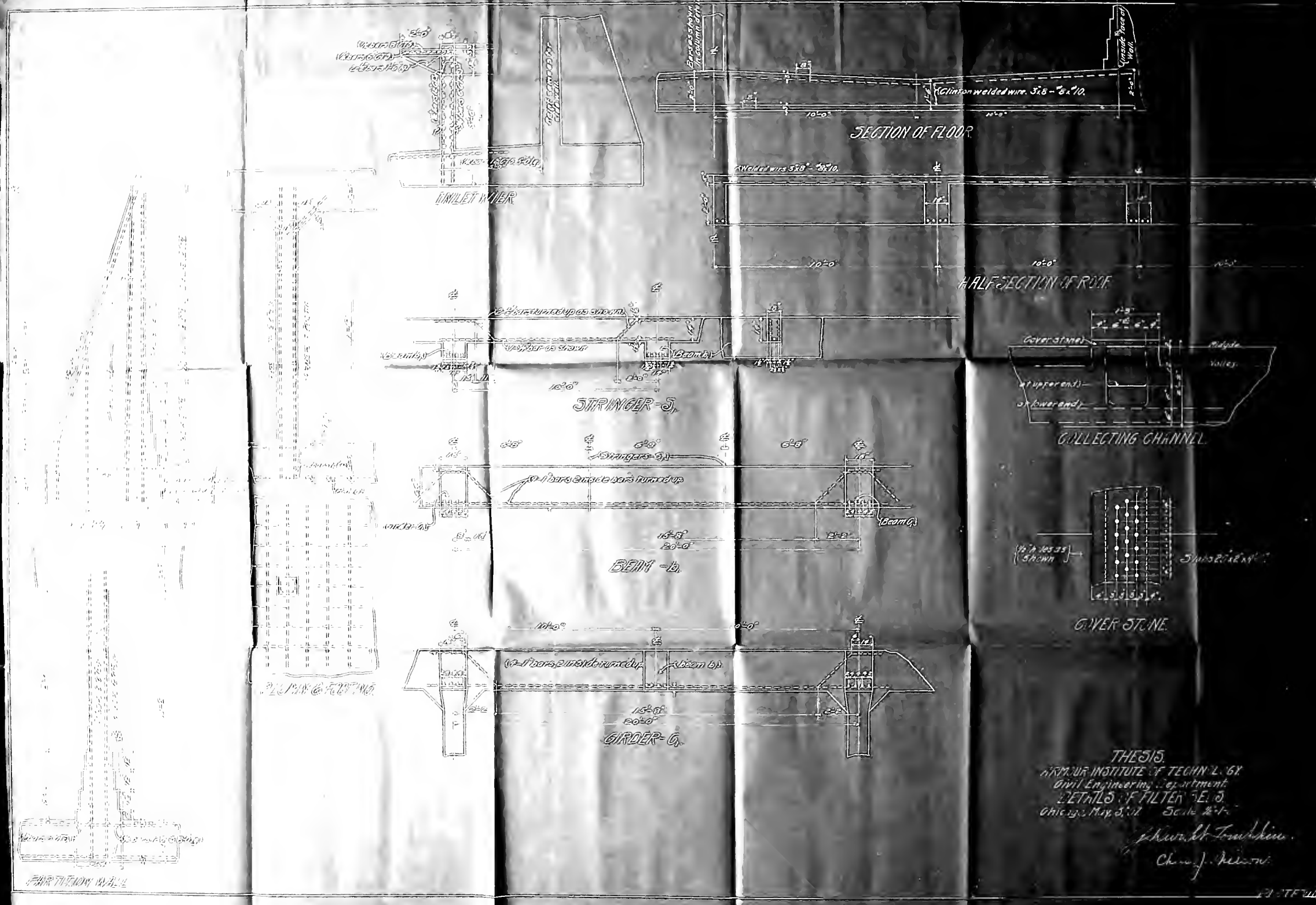
GENERAL SPECIFICATIONS.

All concrete to be made of Portland cement in proportions by volume of one part of cement, two parts of sand and five parts of crushed stone. The Portland cement must comply with the specifications of the American Society for Testing Materials. The sand must be clean and free from all organic matter. The stone must be hard, clean limestone screened to pass a one inch screen and to be held on a one-half inch screen.

All material to be subject to the approval of the engineer in charge. The steel is to be "Ransome Cold Twisted Bars", of medium steel.

SAND FOR FILTER BEDS.

The gravel shall be clean and free from all impurities and placed to a height of one foot above the centers of the lateral drains. The gravel to be graded upward from two inches to sand. The fine sand to be used in the filter beds shall be clean, sharp, and of graded sizes, 10% of which by weight must pass a 100 mesh seive. The uniformity coefficient shall be 2.5.



SECTION OF FLOOR
Clinton welded wire. 3"x8" - #8 x #10.
10'-0"
HALF SECTION OF ROOF
Welded wire 3"x8" - #8 x #10.
10'-0"
INLET WIER
STRINGER-S1
BEAM-B1
Stringers-S1
Beam G1
15'-8"
20'-0"
GIRDER-G1
COLLECTING CHANNEL
Cover stones
Ridge
Valley
at upper end
at lower end
COVER STONE
PARTITION WALL
THESIS.
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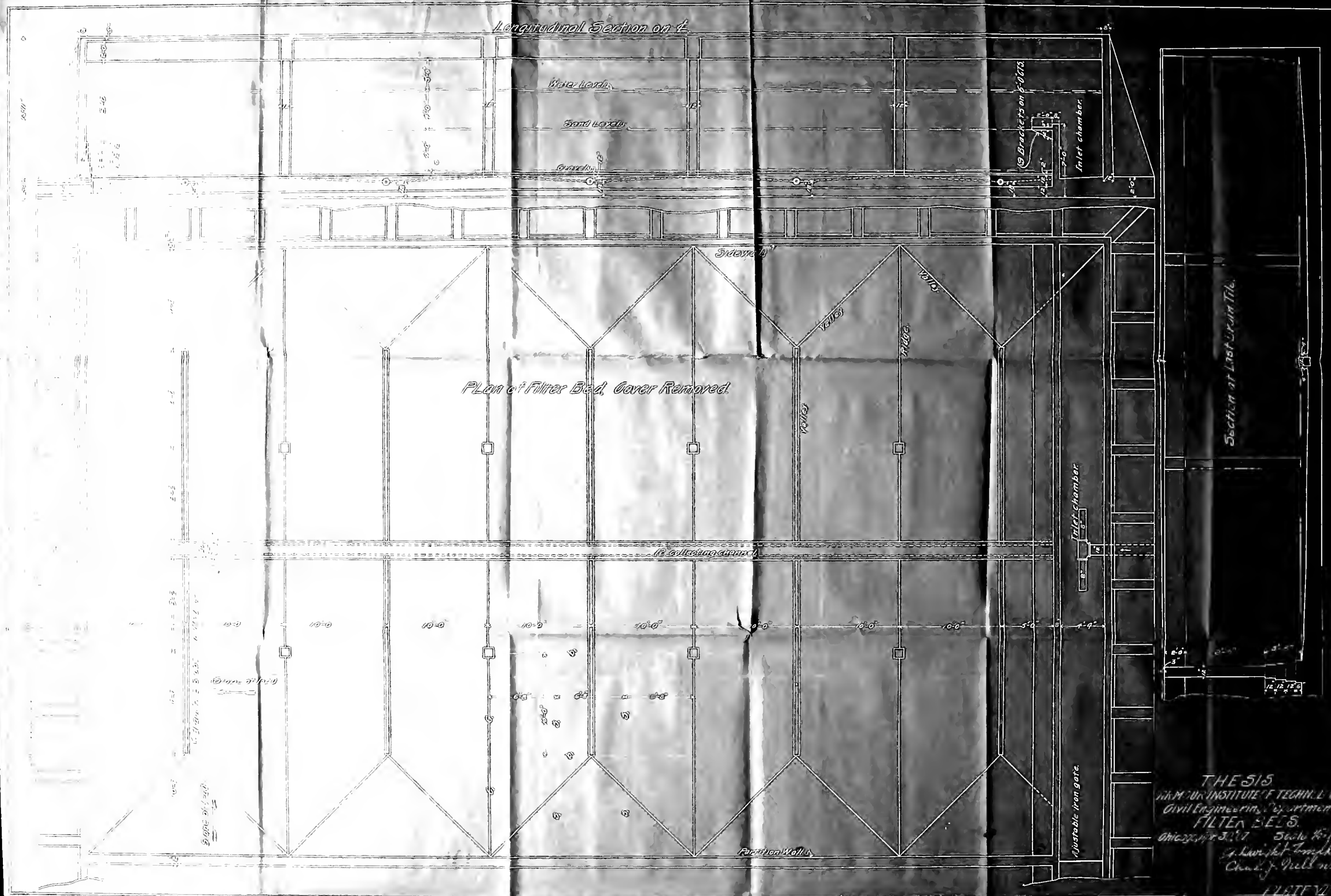
DETAILS OF FILTER BEDS.
Chicago, May 3, '07.



Longitudinal Section on ℄
Water Level
Sand Level
Gravel
Brackets on 6-0 cts.
Inlet chamber
Sidewalk
Valley
Ridge
Valley
Plan of Filter Bed, Cover Removed.
Valley
Inlet chamber
12 collecting channel
Section at Last Drain Tile
Adjustable iron gate
Partition Wall
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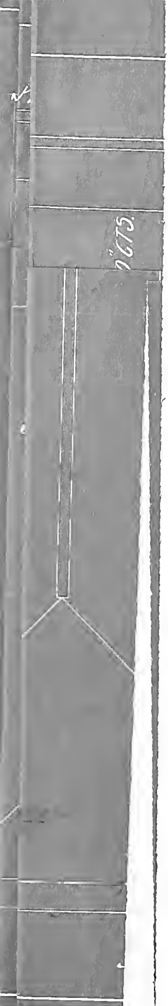
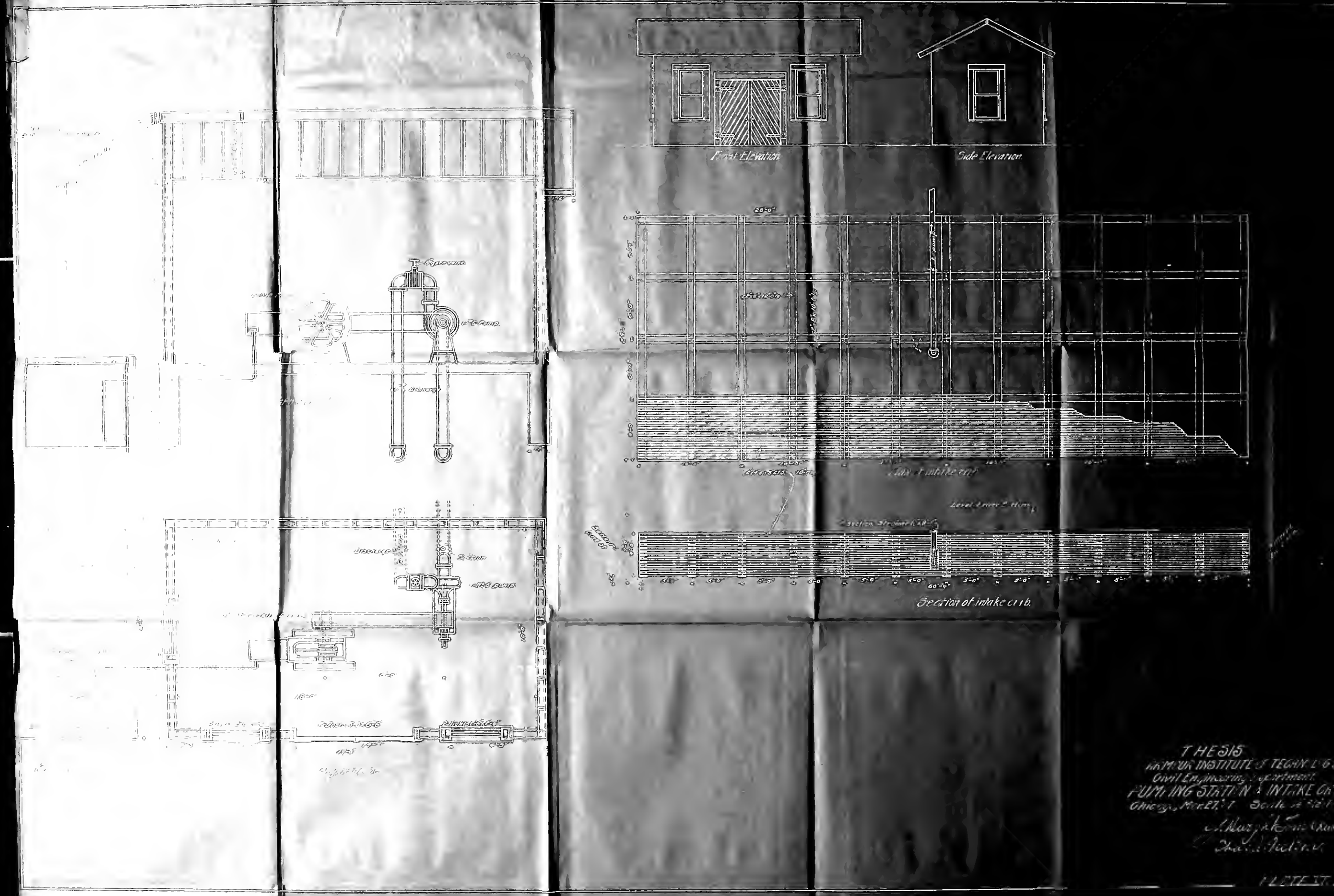
FILTER BEDS.
PLATE VI





Front Elevation
Side Elevation
Section of intake crib
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Civil Engineering Department

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C
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Section thru Sluiceway.
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1'-0"
ARMO
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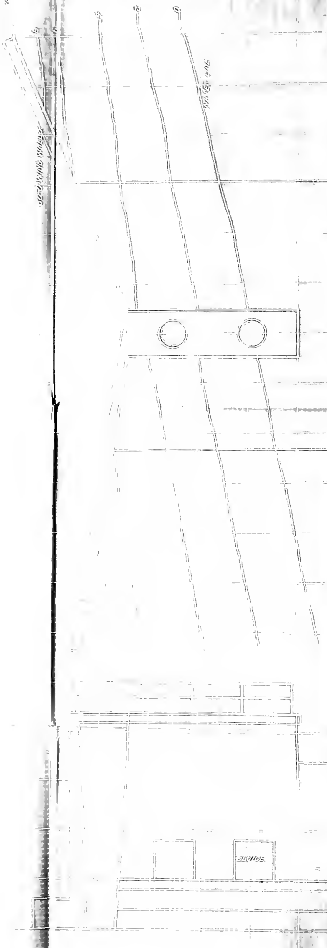

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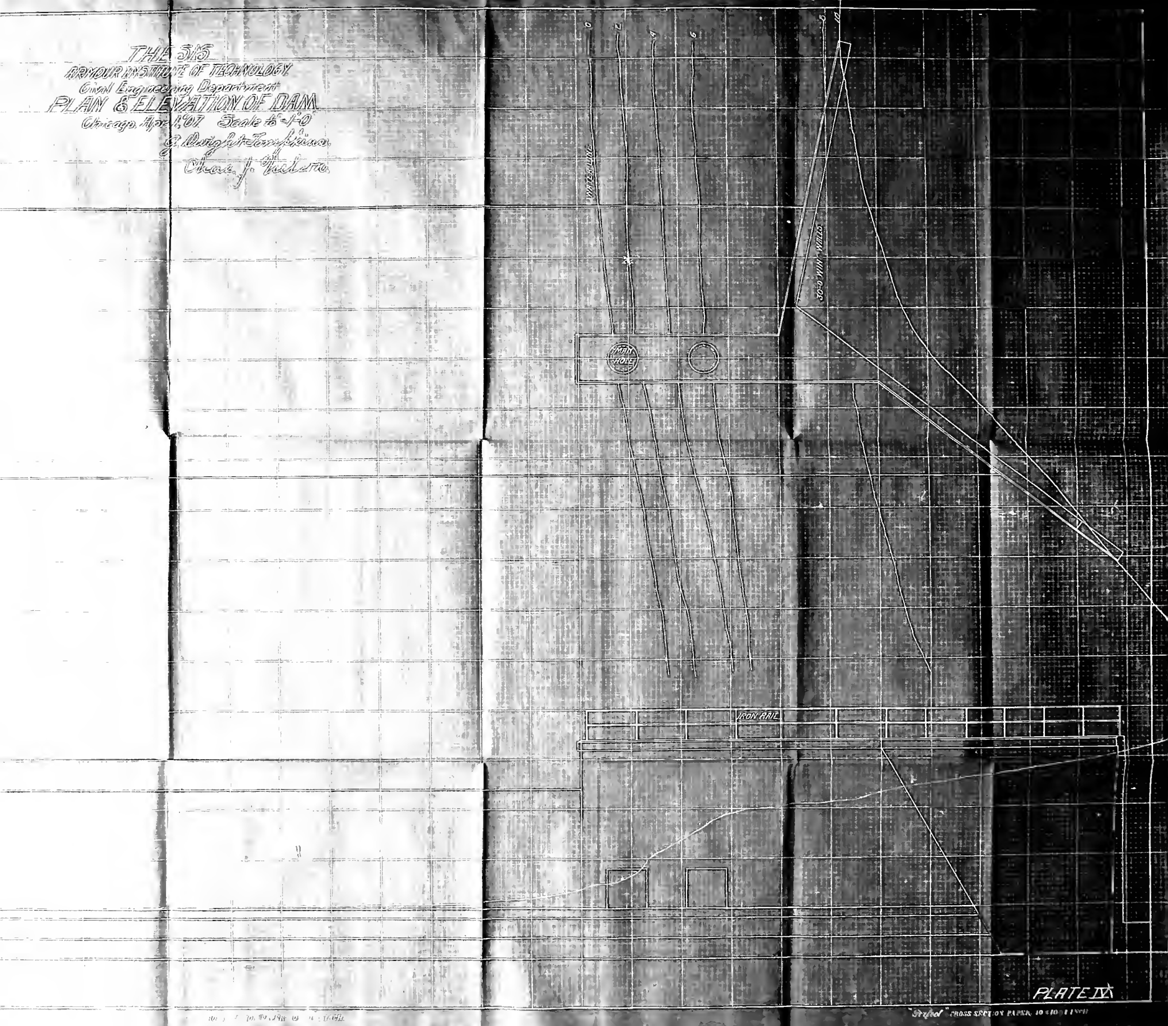
Civil Engineering Department

PLAN & ELEVATION OF DAM

Chicago, Apr 1, '07. Scale 1/10"=1'-0"

G. Dwight Tompkins.

Chas. J. Wilson.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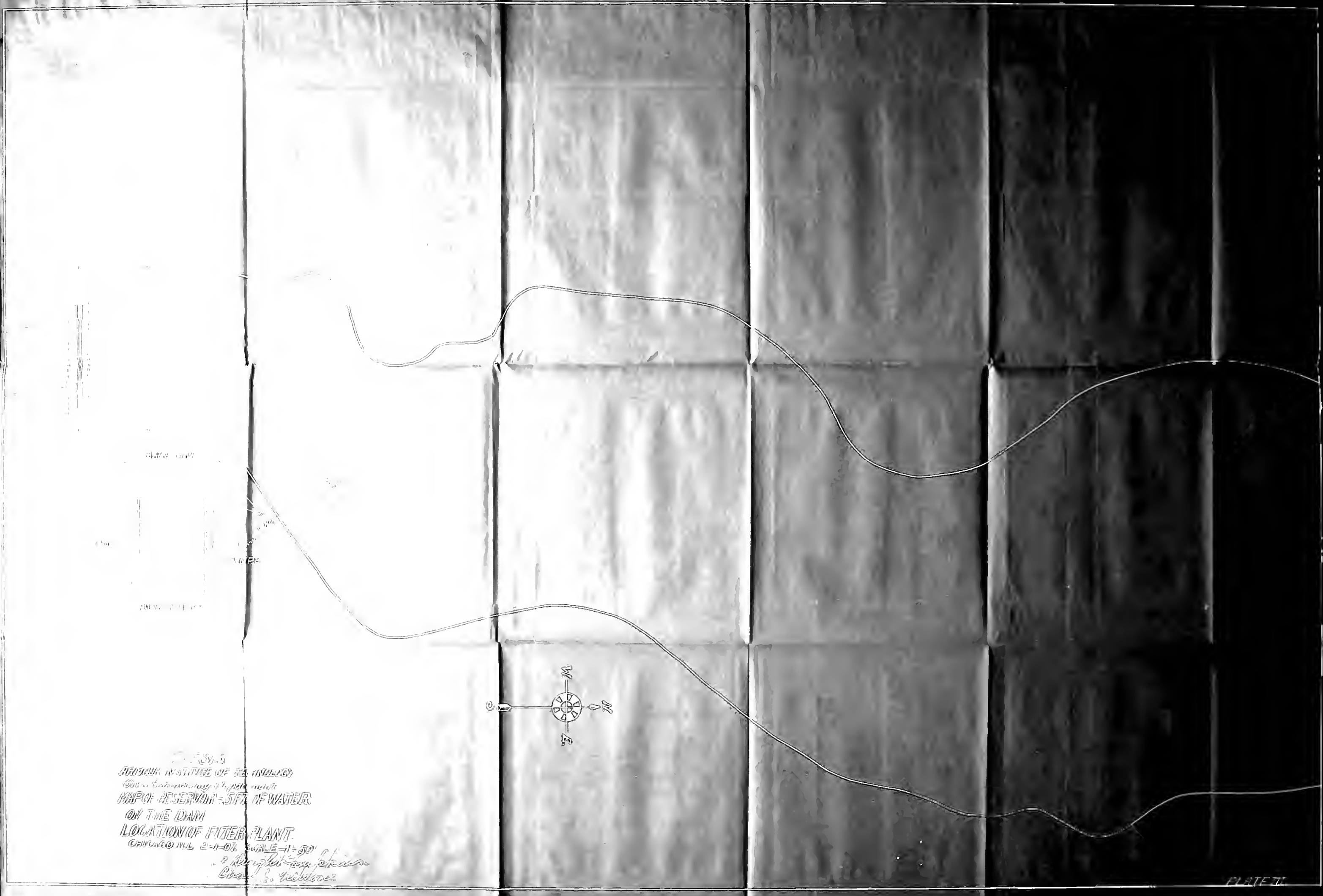
ARMOUR INSTITUTE OF TECHNOLOGY
Civil Engineering Department
PLAN & ELEVATION OF DAM
Chicago, Apr. 1, '07 Scale ¼"=1'-0"
G. Dwight Tompkins
WATER LINE
30-0 WIN WALLS
MAN HOLE
IRON RAIL
PLATE IV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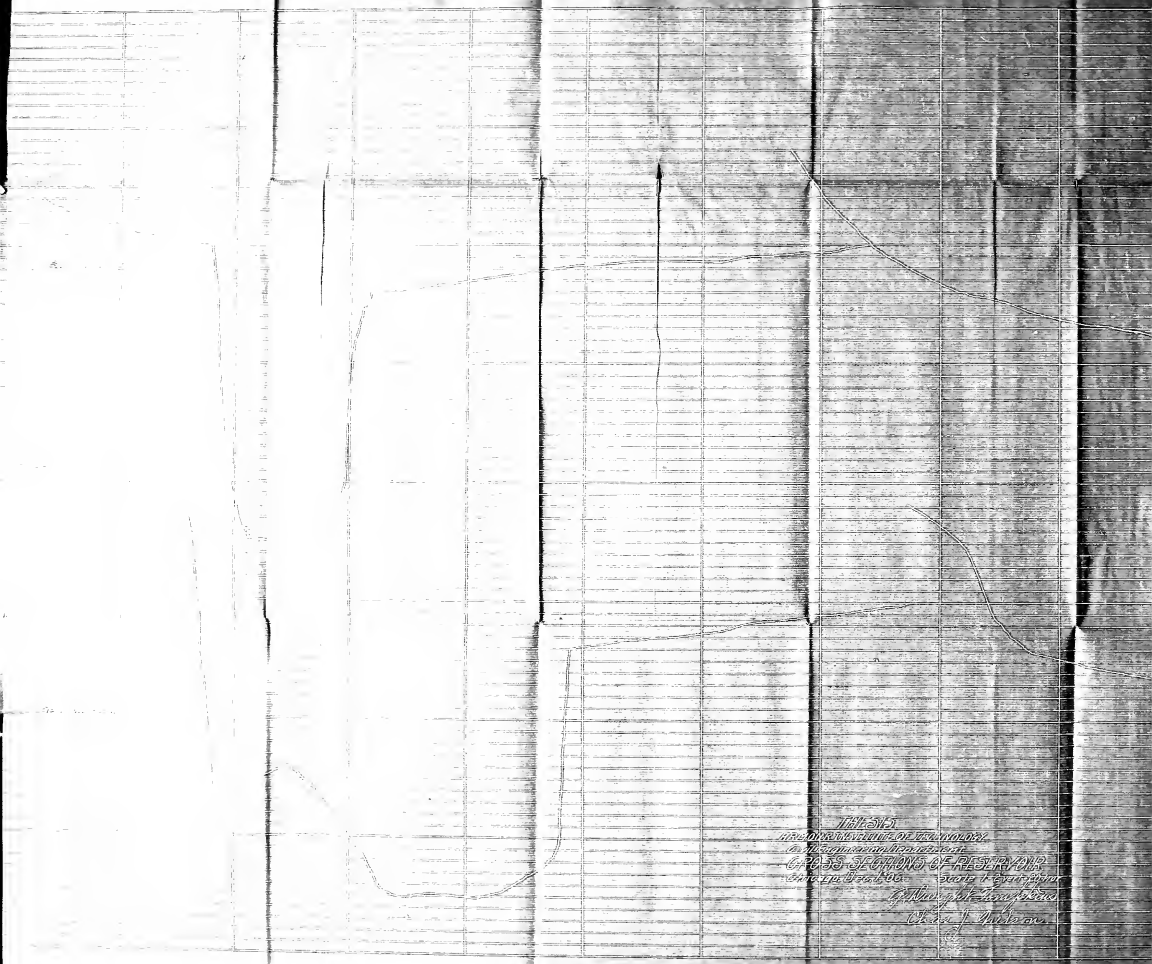
MAP OF RESERVOIR =5 FT. OF WATER
ON THE DAM
LOCATION OF FITER PLANT.
CHICAGO ILL 2-1-07. SCALE=1=50'
PLATE II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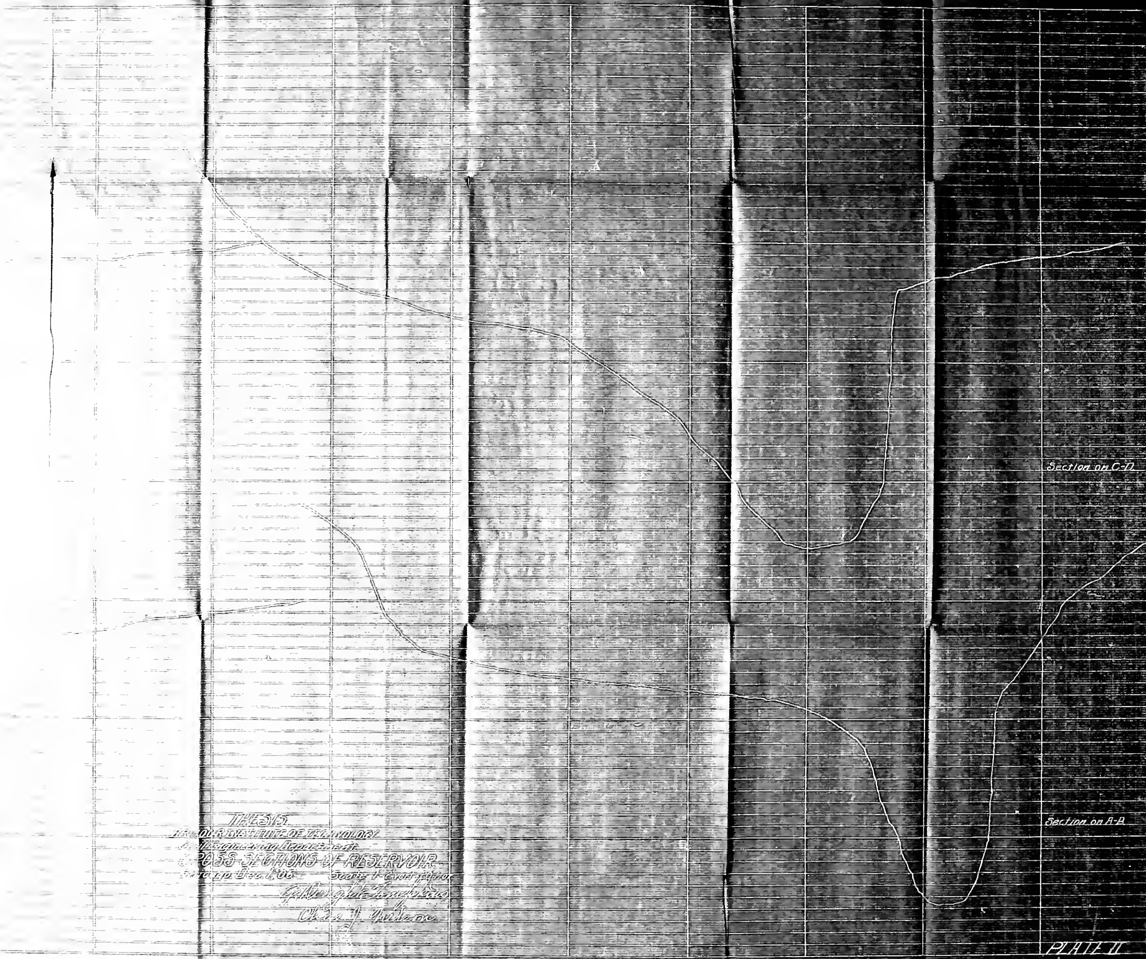
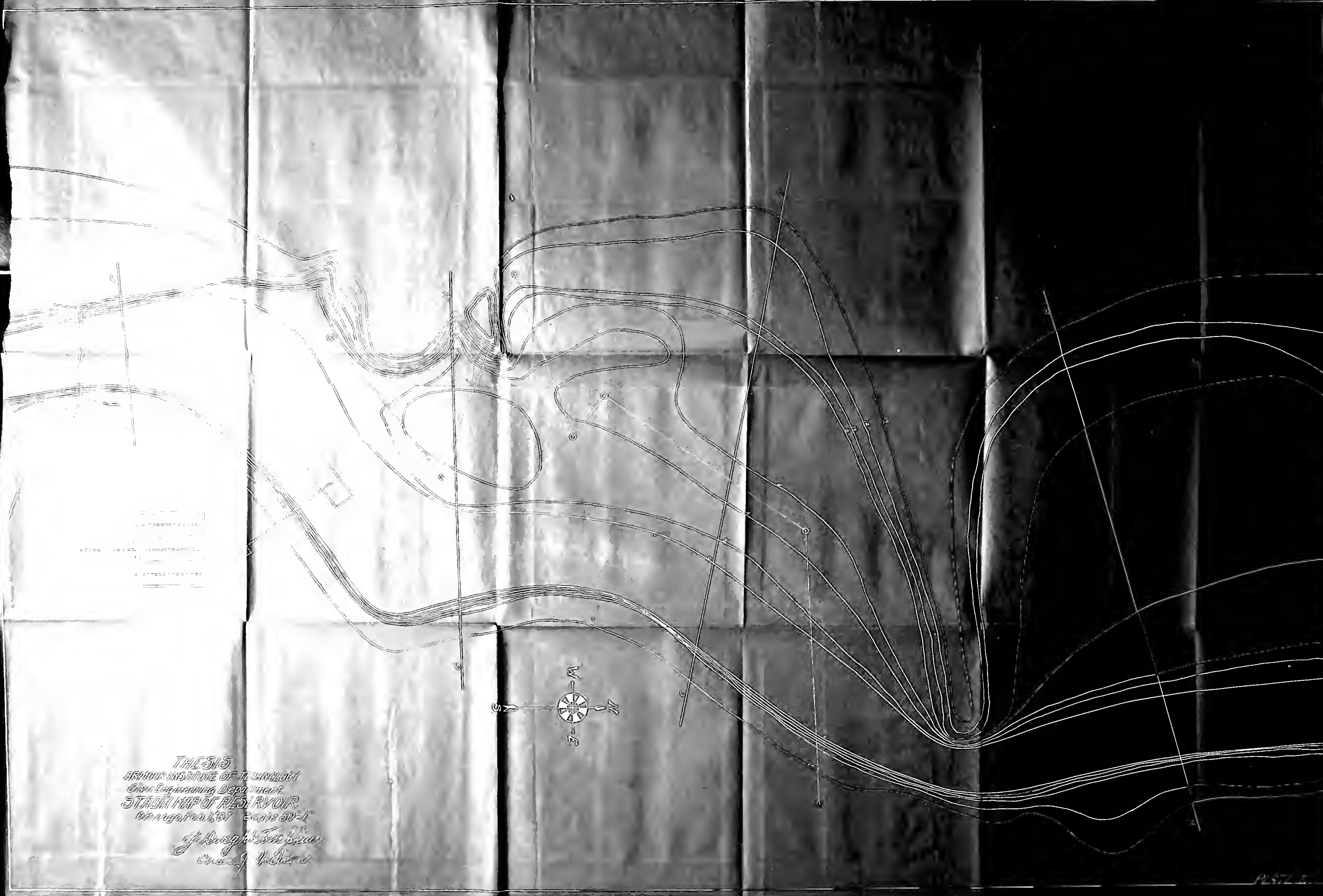
ARMOUR INSTITUTE OF TECHNOLOGY
Civil Engineering Department
CROSS SECTIONS OF RESERVOIR.
Chicago Dec. 1, '06
Chas. J. Wilson


Section on C-D
Section on A-B
THESIS.
CROSS SECTIONS OF RESERVOIR.
PLATE II


THESIS
ARMOUR INSTITUTE OF TECHNOLOGY
Civil Engineering Department
STADIA MAP OF RESERVOIR
Chicago, Feb. 1, '07   Scale 50'-1"
W
N
E
S